4- Transformers

4-1 Introduction:

One of the main advantage of A.C transmission and distribution is the case with which an alternating voltage can be increase or reduce. The general practice in this country is to general at voltage of about 1-22 kV, then step up by means of transformers to higher voltages, for transmission lines, at suitable points other transformers are installed to step the voltage down to values suitable for motor, lamps heater, etc. Medium size transformers have a full-load efficiency of about 97-98 per cent, so that the losses at each point of transformation is very small. Also, since there are no moving parts, the amount of supervision required is practically negligible.

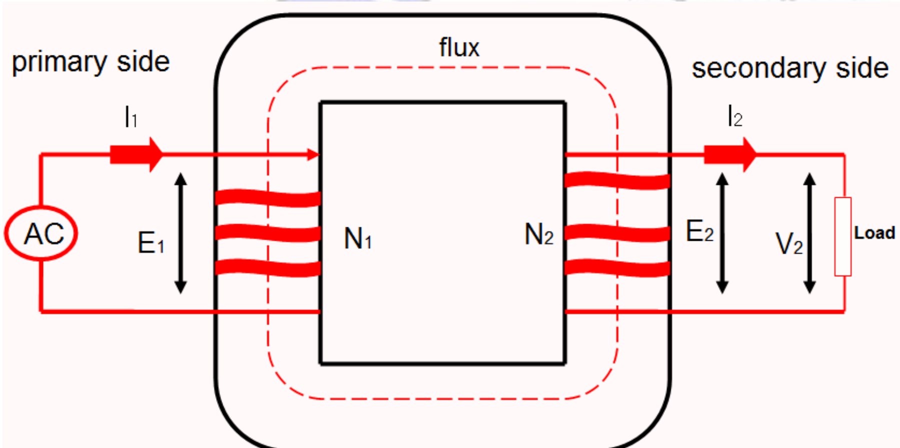
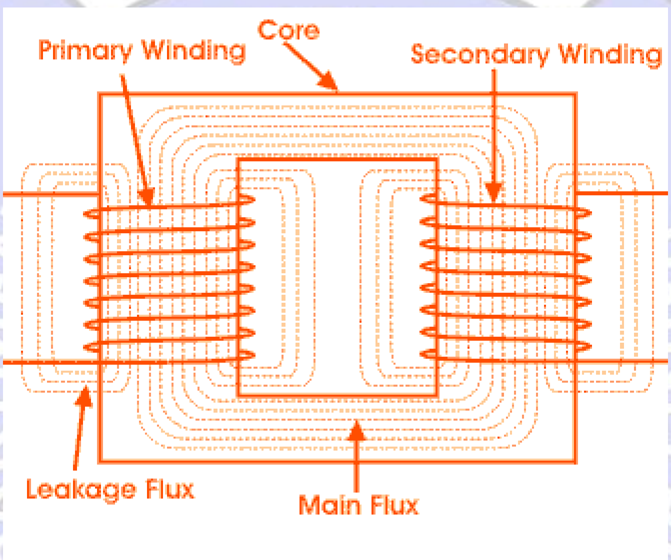


Figure 1: Transformer

4-2 Leakage Flux Responsible for The Induced Reactance of a Transformer:

In the preceding discussion, it has been assumed that all the flux linked with primary winding also links the secondary winding but, in practice it's impossible to realize this condition. It's found, however that all the flux linked with primary does it link the secondary but, part of it known $\emptyset_{L1}$ completes its magnetic cct. By passing air rather than around the core. The preceding section it was explain that the leakage flux is proportional to the primary and secondary current and that has effect is to induce e.m.f of self-induction in the winding. Consequently, the effect of leakage flux can be considered as equivalent to inductive reactors X_1 and X_2 connected in series with a transformer having no leakage flux.



4-2-1 Methods of reducing leakage flux:

The leakage flux can be practically eliminated by winding the primary and secondary, on over the other, uniformly around a laminate iron ring of uniform cross- section but, such an arrangement is not commercially practicable except is very small sizes. Owing to the cost of threading a large number of turns through the ring.

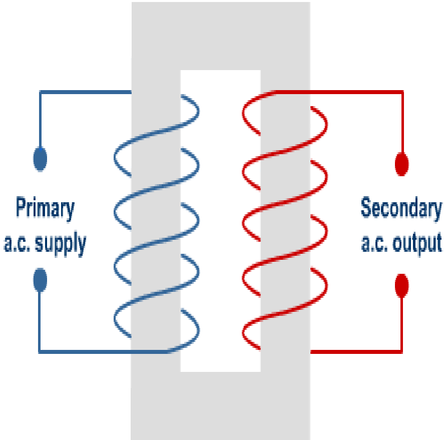
The principal methods used in practice are:

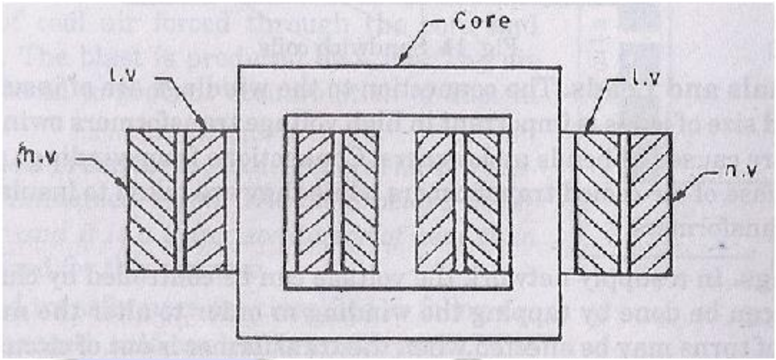
1-Making the transformer (window) long and narrow.

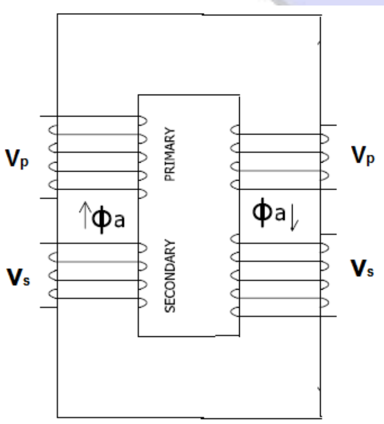
2-Arrangment the primary and secondary winding concentrically.

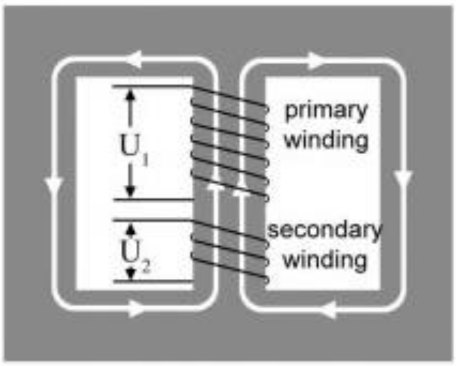
3-Sandwiching the primary and the secondary winding

4-using shell-type construction.









4-3 Principle of Action of a Transformer:

Fig (1) shown the general arrangement of transformer iron core (C) consist of laminated sheets, about 0.35mm thick, insulated from one another by thin layers paper or varnish or by spraying the laminations with a mixture of flour. The purpose of laminating the core is to reduce the loss due to eddy current induced by alternating magnetic flux. The primary coil is connected to supply and the secondary coil is connect to the load. An alternating voltage applied to primary circulated an alternating current through primary and this current produces an alternating flux in the iron core. The mean path of this flux being represented by the dotted D_1. If the whole of the flux produced by primary passes through secondary, the e.m.f induced in each urn is the same for P and S. Hence, if N_1 and N_2 be the number of turns on (P) and (S) respectively.

$$\frac{\textbf{Total e.m.f induced in S}}{\textbf{Total e.m.f induced in P}} = \frac{N_2 \ X\ e.m.f\ per\ turn}{N_1\ X\ e.m.f\ per\ turn} = \frac{N_2}{N_1}$$

When the secondary is on open circuit, its terminal voltage is the same as the induced e.m.f .The primary current is then very small, so that the applied voltage V_1 is practically equal and opposite to the induced in P hence:

$$\frac{V_2}{V_1} \approx \frac{N_2}{N_1}$$

Since the full-load efficiency of a transformers is, in early 100 per cent.

$I_a\, V_1\ X$ primary power factor $\approx I_2\, V_2\ X$ secondary power factor, but the primary and secondary power factor at full-load are nearly equal, $\frac{I_2}{I_1} = \frac{V_1}{V_2}$ And the we have:

$$\frac{I_2}{I_1} = \frac{N_1}{N_2} = \frac{V_1}{V_2}$$